# Israel Kleinberg: Oral biology north and south

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Northern exposure

Our first "exposure" to Izzy Kleinberg occurred in the fall of 1959 (almost 40 years ago-unbelievable!). We were both: (1) first-year dental students at the University of Manitoba in Winnipeg, Canada (a mid-size, Midwestern city north of North Dakota, on the same infamous Red River that flooded Grand Forks, ND, in the spring of '97-1997, that is), and (2) members of the second class of students in the then-newlyestablished School of Dentistry. Izzy was just in his second year of teaching medical biochemistry to the combined class of first-year dental and medical students. At that time, the dental students and medical students took essentially all of their basic science courses together during the first two years of the four-year curriculum, a practice not as common then as it is today.

Izzy was tough! Of all the biochemistry faculty, he gave us the most material per lecture (phys-chem of acid-base balance, redox potential, intermediary metabolism, etc.), was tougher on the dental students than the medical faculty was, and seemed to delight in having the highest failure rate on his lecture material. It didn't get any better when he taught us second-year dental science (the precursor of Oral Biology), a course which dominated the second-year curriculum and which made all other classes in that year, from medical microbiology to pathology and pharmacology, seem easy by comparison.

Years later, we came to realize that this was his way of pushing us to achieve much more than we thought we could, and to reach for true excellence. His goal, during those first few years of the dental school's existence, was to capture adequate time in the curriculum to teach an intensive oral biology course built on basic science prerequisite courses, and, in the process of "inventing" this oral biology course for dental students, he was trying it out on us. He was constantly forced to convince dental and medical faculty alike that Oral Biology was a legitimate discipline in the curriculum, essential for the training of the biologically and disease-oriented modern dentist. Good thing he "trained" himself to survive on three hours of sleep per night in those early days, a habit he has largely retained to this day. But what did we Manitoba dental students know about any of this? We thought that all dental students in Canada and the United States suffered through Oral Biology courses. Deja vu: Even in 1998, our dental students at Stony Brook think that the intense Oral Biology courses that they take under Izzy Kleinberg throughout the four-year curriculum are also experienced by other dental students throughout the country. Of course, they learn otherwise when they meet graduates of other dental schools during their post-graduate training programs. This experience has been repeated often enough since 1973 (when the school at Stony Brook first opened) to assume myth-like proportions. This may be one reason why both the Stony Brook and Manitoba dental schools have had a disproportionately high success rate in having their graduates accepted into postgraduate and graduate programs and achieving distinction in practice, academics, industry, and government.

Izzy's odyssey: from Canada to England and back again

After completing his dental degree at the University of Toronto in 1952, Izzy engaged in three years of general practice in the northern woods of western Ontario, Canada. As he recollects with fond nostalgia, those were good times, time for fishing on isolated pristine lakes, much reading of Spinoza's philosophy, and contemplation. Afterward, he went to Newcastle-upon-Tyne (University of Durham, UK) in 1955, where he began his PhD studies in physiologybiochemistry under Dr. G. Neil Jenkins. Dr. Jenkins was a PhD graduate from the University of Cambridge and one of three Nuffield Lecturers whose positions were specially created to increase the biology content of dental curricula. Of the three, Dr. Jenkins was the only one who was not a dentist. Despite this, he was able to make a major contribution to academic dentistry by initiating the study of the physiology of the mouth and, today, is recognized as a pioneer in this field. For Izzy, joining Dr. Jenkins as his PhD student (on the advice of Dr. John B. MacDonald, one of Iz's teachers at Toronto and the "builder" of Forsyth Dental Center in Boston into the research enterprise it became) was fortuitous. For one thing, Dr. Jenkins had completed a heroic effort of collecting and correlating the existing information in Oral Physiology in a book (Jenkins, 1953) which proved to be an important pillar in the subsequent creation of Oral Biology as an academic discipline. For another, he introduced Iz to dental plaque and saliva, which have proved to be central to so much that occurs in the oral cavity. And last, based on Iz's repeated stories about those early years, the two found that they had a similar love of and addiction to research. Iz's dental and Dr. Jenkins' nondental backgrounds complemented each other; they both enjoyed exchanging views on many subjects. Most importantly, they both believed strongly that teaching and research are inseparable and that one without the other leads to academic sterility.

With fortunate timing, the opening of a new dental school at the University of Manitoba in Winnipeg occurred as Izzy was completing his PhD program at Newcastle in 1958, and he was one of the first faculty recruited by its founding dean, Dr. John W. Neilson. This provided Izzy with a rare opportunity to introduce and test his new ideas and educational concepts before the four-year curriculum could gel.

Like others, Izzy recognized that a major problem in dental education at the time (and for years before and still today) was how to develop dentally relevant science and how to incorporate new findings from research into dental education for the ultimate purpose of providing new and better approaches to oral care for the general public. His initial academic assignments were traditional for a DDS/PhD of those times and included research in the areas of dental plaque, saliva, and dental caries, as well as teaching in basic biochemistry to the first-year dental and medical students. Going beyond this became possible when the second year of the dental curriculum had to be developed for the first class of the new school. Ample time was available because only some of the dental faculty had as yet been recruited. This enabled a significant amount of oral biological science to be introduced, mainly oral biochemistry, oral physiology, and oral microbiology. When the contents of the last two years of the curriculum were developed, it was possible to include some clinically applicable oral biological science and some oral diagnostics technology as well. Thereafter, little change was possible, as additional faculty were being recruited and laid claim to all of the remaining curriculum hours. Never one to be deterred for long, especially by conventional wisdom, Izzy then developed the first free-standing PhD program in the field: An MS program in Oral Biology was begun in 1961 as a steppingstone to the PhD program which followed in 1963. The first two PhD graduates were Jim Sandham and Hershall W. Kaufman in 1967. Lome Golub, a contemporary of theirs, because of his combined interest in clinical and in research applications, took the two-year MS degree route, which he received in 1965, and then took the long trip south (?) to Boston (only from a Winnipeger's perspective is Boston considered "south"!), where he did three years of post-graduate training in Periodontics at the Harvard School of Dental Medicine, including bone and collagen research with Paul Goldhaber (HSDM) and Mel Glimcher (Orthopaedics, Harvard Medical School). Generous support from the National Research and Medical Research Councils of Canada, in the form of fellowships, ensured their training and that of others who followed, many becoming professors, department chairmen, deans, and even one university president, in Canada, the USA, and elsewhere in the world.

Southern exposure

In 1973, a new dental school was started at Stony Brook, New York, as part of a whole new health sciences complex, including a tertiary-care hospital; all of this was part of a totally new university campus. The budget, for a brief happy time, was then almost limitless, and, as at the University of Manitoba, there was no entrenched curriculum with which to contend. Izzy found the invitation impossible to resist and, with the two authors and six others, together with the initial physical and equipment resources provided, was able to rapidly put together what had taken a period of 15 years at the University of Manitoba to acquire and build. Approximately twice as much was to have followed. Unfortunately, the latter did not materialize, because New York City's financial difficulties in 1975 nearly bankrupted New York State. Nevertheless, sufficient resources had been obtained to support almost

instantaneous rebuilding and implementation of a major step forward in Oral Biology development. In 1973, Izzy immediately initiated a clearly defined core course of 158 didactic hours within an Oral Biology departmental structure. This Oral Biology course, taught to the second-year dental students after they had completed most (not all) of their basic science courses with the medical students, consisted of seven oral systems or areas, including: (1) the biology of the oral mineralized tissues, (2) the biology of the salivary glands and their secretions, (3) the oral microbial systems, (4) the biology of the oral mucosa and periodontium, (5) the oral neural and chemical sensory systems, (6) the oral neuromotor systems, and (7) genetics and developmental biology of the facial and oral structures. Most individuals thought that even for him, Iz had gone too far astray when he recruited Lorne Taichman, an MD graduate from the University of Toronto and a PhD in bacterial and molecular genetics from the University of Wisconsin (Madison), to develop an academic program in genetics. This Lorne did, and he was one of the earliest advocates of gene therapy as a new means of treating many disease conditions.

With the second-year Oral Biology course and its novel "systems" format in place (and the MS and PhD programs approved by Stony Brook's School of Graduate Studies at essentially the same time), Izzy then turned his attention to another long-held dream-having the dental students apply Oral Biology in their clinical practice at the chairside. Accordingly, he initiated a follow-on course for the thirdand fourth-year **dental** students called Oral Diagnostics (i.e., Applied Oral Biology-not to be confused with the traditional field of Oral Diagnosis). The new course involved the teaching of the underlying science and the development of new biologically based (and other) laboratory and clinical diagnostic techniques that would be needed to provide more sensitive and objective tests for detecting and monitoring the **treatment** of oral diseases, so that the patient could be managed in an increasingly scientific manner. In brief, this course consisted of two parts: The first was a theory and clinical demonstration course for the third-year **dental** students, consisting of 42 hours in five major topic areas: (1) the basis of measurements, indices, scientific and clinical validity, including clinical trials, and how research evolves into practical diagnostic techniques and therapeutic agents, and patenting, manufacturing, marketing, and regulatory requirements; (2) technology and methods of in situ examination, sampling and analyzing the oral soft and hard tissues, and performing genetic **analyses** and tests; (3) methods of in situ measurement of saliva and gingival crevicular fluid, as well as their collection, **analysis**, and diagnostic application, along with traditional aspects of collection and **analysis** of blood and urine; (4) microbiological and biochemical techniques for examining plaque and the oral microbiota and their diagnostic applications; and (5) principles and use of a wide variety of electronic and electro-optical instruments in oral diagnostics. The second part involved having the fourth-year **dental** students perform such diagnostic techniques on some of their patients in the clinic and teaching them how to integrate this extra information into the more traditional aspects of their **treatment** plan.

To reach this aspect of curriculum development, Iz had long ago recognized that there were two major hurdles, neither of which would be easy to overcome. One was the paucity of diagnostic hardware and related therapeutics available for the management of the dental patient. Second was the hurdle of their incorporation into patient management protocols, which were and still are largely focused on repair. To accomplish the first required the help of industry and much greater interactions between academe and industry than the conventional wisdom was ready to accept. It also required (which he strongly encouraged) that his faculty constantly be alert for clinical applications of their basic research to provide the hardware needed for the Oral Diagnostics program. As a consequence, hosts of new diagnostic and therapeutic technologies were invented and old ones updated (Kleinberg, 1990). As a side-effect, the Oral Biology Department became a leader in technology transfer at Stony Brook. It is now one of the top departments at Stony Brook University (and in the SUNY system) in industrial grants and numbers of patents awarded. This strategy helped the dental school achieve recognition as a significant contributor to the overall mission of this research-oriented public university, rather than being viewed, as many dental schools unfortunately are, as peripheral educational entities.

Izzy's untiring efforts on behalf of promoting the new discipline of Oral Biology and working out the details of these new courses and teaching programs contributed to the formulation, by the American Association of Dental Schools, of guidelines for an Oral Biology curriculum in 1984 (Kleinberg and Shapiro) and, in 1986, for another set of guidelines for Oral Biology PhD programs (Kleinberg and Suddick). Then, in 1988, Izzy, together with Dr. Richard Suddick and the support of over a hundred committed oral biologists, founded the American Association of Oral Biologists (AAOB). While still a fledgling organization, it has been able to serve legally and otherwise as a watchdog of oral biologists' interests in ensuring the growth and development of dentistry's oral biological teaching and research base. The organization adopted the newly established and highly respected journal, Critical Reviews in Oral Biology & Medicine (ably edited and nurtured by Olav Alvares, 1990), as its official journal. This has given many, both inside and outside the dental community, a clear idea of the scope of Oral Biology and a reason to be proud of the quality and accomplishments of Oral Biology's scholarly activities.

Summary of a unique career

Izzy Kleinberg has been and continues to be a true visionary in academic dentistry. His accomplishments include pioneering advances in both dental education and dental research. In education, perhaps his greatest contribution has been the early (and still continuing) development of Oral Biology as an educational (as well as research) discipline at both the pre-doctoral and graduate levels. His often unconventional yet prophetic views and his recognition more than 20 years ago that the job market for graduate students upon completing their studies was shifting are in part reflected by the fact that more than half of the numerous PhD and other students he and the Department have trained, since moving to Stony Brook, have been recruited into health-related industries. Many now occupy high executive offices; three are corporate-level vice-presidents.

His research has run the gamut of basic studies on: the microflora of the mouth and, more recently, those of the skin and vagina; the intermediary metabolism of dental plaque and its relationship to the pathogenesis of caries, periodontal disease, and oral malodor; various aspects of saliva composition and physiology, including the discovery of small arginine peptides (Sialin) to stimulate an alkaline plaque pH and reduce dental caries; and the development of various devices for oral diagnostic and research purposes, such as microelectrodes to study plaque and crevicular fluid pH and Eh, the intra-oral ultraviolet camera, the modified Halimeter for oral malodor measurement, and, with his coinventors Lorne Golub, Sam Borden, and Morris Settler, an electronic micromoisture meter, the Periotron, to quantify the flow rate of GCF and, more recently, salivary gland secretions and oral mucosal wetness. Not generally recognized is that the invention of the Periotron and its commercial development and availability to the research community have resulted in more than 2,000 publications based, at least in part, on this invention, creating an immense knowledge base about oral fluids. More than 150 publications (and even more published abstracts) in a variety of dental, medical, and biochemical journals are one outcome thus far of Iz's many research efforts.

Izzy has repeatedly been in the forefront of other dental (and other) academics in arguing for programs of industrialuniversity interactions and the importance of technology transfer. This, he strongly believes, is the vehicle for payback to the public for its support of the basic research that is at the core of a university's existence. The idea of university-industry interaction, which is now increasingly accepted within the university at large, was one that he pursued several decades before its current popularity. Shortly after coming to Stony Brook, he took a leadership role in helping former ©SUNY at Stony Brook University President John Toll and New York State Senator Kenneth LaValle bring about the changes in the ©SUNY patent policy that have contributed to Stony Brook's success in technology transfer. Besides his own patents of value to the university, he has stimulated his faculty and former students to do the same with notable successes. Almost every member of the faculty in his department has been awarded such patents. Most significantly, these have spawned three companies and two "incubator" relationships with Stony Brook University, and more are expected to be centered around the Department's training and research programs.

Among Izzy's numerous academic awards, the one he most cherishes occurred in 1983, when he received the Honorary Doctor of Science degree from the University of Manitoba (Canada), together with his former mentor, Neil Jenkins, on the occasion of the 25th anniversary of the founding of its dental school and the 100th anniversary of the founding of its medical school. Both of these pioneers were recognized for their achievements in teaching, research, and, most importantly, for their contributions to the training, in oral biological science, of numerous dental practitioners and scientists. Although we are nearing the later "acts" of a remarkable "performance", it is hard to imagine Oral Biology worldwide without Izzy Kleinberg "center stage".

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